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DEPARTMENT OF DEFENSE

UNMANNED AERIAL VEHICLE

MASTER PLAN

1991

1 MARCH 1991

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GLOSSARY OF TERMS

Unmanned Aerial Vehicle (UAV) - A powered, aerial vehicle that does not carry a human operator, uses aerodynamic forces to provide vehicle lift, can fly autonomously or be piloted remotely, can be expendable or recoverable, and can carry a lethal or nonlethal payload. Ballistic or semi-ballistic vehicles and artillery projectiles are not considered UAVs.

Lethal UAV - A UAV, normally autonomous and expendable, that carries a payload used to attack and damage and/or destroy enemy targets.

Nonlethal UAV - A UAV that does not carry a payload for physical damage and/or destruction of enemy targets. A nonlethal UAV carries payloads for missions such as reconnaissance; surveillance; target acquisition; target spotting; command and control; meteorological data collection; nuclear, biological, and chemical detection; special operations support; and electronic disruption and deception. In the context of this document the term "UAV" is equivalent to the term "nonlethal UAV".

Remotely Piloted Vehicle (RPV) - A nonautonomous UAV, that is, one that is controlled through a data link by a human operator.

Conventional Standoff Weapon - An unmanned, surface attack, powered or unpowered ballistic missile, semi-ballistic missile, cruise missile, or UAV having an explosive or otherwise lethal non-nuclear warhead and having an effective operational range exceeding five nautical miles from its lowest operational launch altitude. Army deep fire systems are considered standoff weapons, but Army artillery and artillery-like close fire systems are not.

The following additional terms used throughout this document pertain to qualities or characteristics of UAVs:

Category of UAV Requirements - Close, Short, Medium, and Endurance.

Commonality - Systems or subsystems with interchangeable repair parts and/or like and interchangeable characteristics so that each can be used or operated and maintained by personnel trained on the others without additional training.

Family - The set of UAV systems that maximizes interoperability and commonality.

Interface - The physical, electrical, environmental, and functional hardware and software requirements, characteristics, and constraints that exist at a common boundary between two systems.

Interoperability - The ability of systems, units, or forces to provide services to and accept services from other systems, units, or forces and to use the services so exchanged to enable them to operate effectively together.

Subsystem - The major elements of a UAV including: air vehicle, mission planning and control station, mission payload, data link, launch and recovery, and logistics support.

I. INTRODUCTION

In 1988 Congress directed the consolidation of UAV programs within the military Services into a joint program managed by the Office of the Secretary of Defense (OSD) and the submission of a UAV Master Plan. The first UAV Master Plan was submitted to Congress on 27 June 1988. Subsequent updates were submitted in 1989 and 1990. This Plan is the third update and provides the 1991 status of nonlethal UAV programs and an overview of requirements, program plans, management, and acquisition strategies. Lethal UAV programs are reviewed in the DoD Standoff Weapons Master Plan. The UAV Master Schedule, Appendix A, will be updated and disseminated to coincide with the periodic reviews of the UAV program by the UAV Executive Committee (EXCOM).

The 1990 accomplishments and achievements in the UAV program include:

- Continued successful operational demonstration testing of the Pointer UAV. Army and Marine Corps units deployed the system in support of Operation Desert Shield/Storm.

- The Pioneer UAV was successfully deployed as part of Operation Desert Shield/Storm on two Navy battleships and in three Marine Corps RPV companies and one Army platoon.

- Milestone 0 reviews for the Close Range and Endurance UAV categories of requirements were completed.

- Foreign Comparative Testing programs for Sprite, CL-227, and the Raven UAVs were completed.

- A Foreign Comparative Testing program with the navies of the United States (U.S.), Canada, Germany, the Netherlands, and the United Kingdom was initiated to conduct an operational demonstration of the CL-227 UAV.

- A program office to manage Very Low Cost UAV programs was established at the Marine Corps Research, Development, and Acquisition Command at Quantico, VA.

- The first phase of an independent cost and operational effectiveness analysis of the family of UAV systems was completed.

- Initial deliveries of hardware from the Short Range UAV program began.

- The procedures for management of UAV joint integration interfaces (JIIs) were established.

- Technology demonstration programs for common core UAV subsystems including a heavy fuel engine, a low cost avionics suite, and an automatic recovery system were initiated.

The 1991 major objectives for the UAV program include:

- Continue support of UAV activities and involvement in Operation Desert Storm.

- Conduct Technical Evaluation Test (TET) and Operational Test IIA of the Short Range UAV.

- Conduct, this summer, the operational demonstration of the CL-227 aboard a U.S. Navy frigate and including the navies of Canada, Germany, the Netherlands and the United Kingdom.

- Evaluate heavy fuel engine and common core avionics demonstration designs.

- Implement a risk reduction program for the Close Range system.

- Continue cooperative development of vertical takeoff and landing (VTOL) UAV technologies.

- In accordance with Congressional direction, continue support of UAV counternarcotic activities with the Drug Enforcement Agency.

- Complete the capstone specification for UAV system engineering and architecture.

- Prepare the design guidance for UAV air vehicles.

- Document and verify the JIIs for air vehicles.

The OSD point of contact for the UAV Master Plan is Col. M. Garrido, OSD(TWP), (703) 695-9284. The UAV JPO point of contact for the UAV Master Plan is Col. B. Brown, PEO(CU)-UA, (703) 692-7842.

II. MANAGEMENT

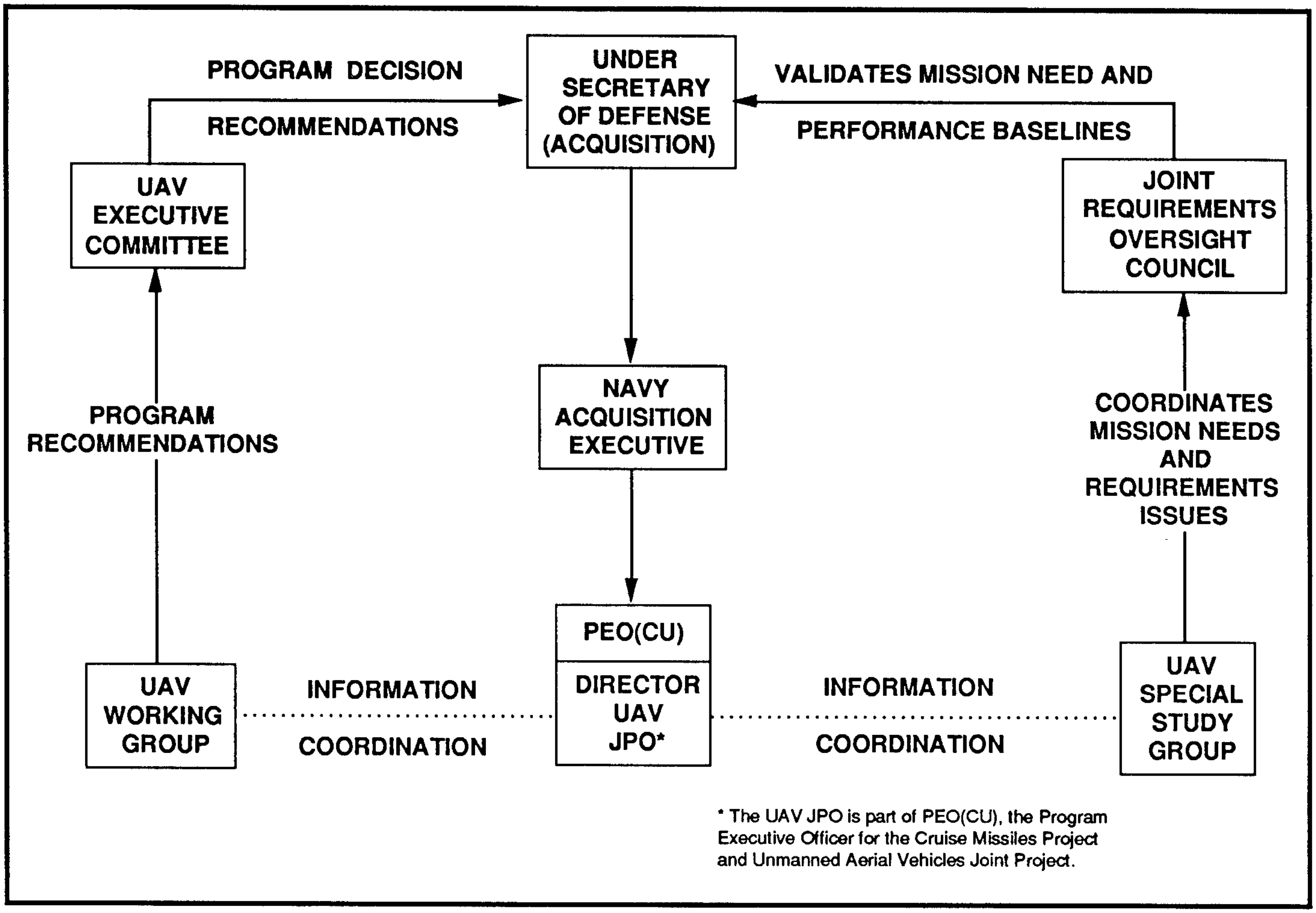


Figure 1 - Management

In response to congressional direction in FY88 to consolidate the management of DoD nonlethal UAV programs, the Under Secretary of Defense (Acquisition) established the UAV EXCOM and the UAV Joint Project Office (JPO) (see Figure 1). The EXCOM was assigned overall responsibility for DoD UAV programs. The Navy was designated the Executive Service for the JPO with full authority, responsibility, and accountability for designing, developing, procuring, and transitioning UAV systems to the Services. The systems must meet the requirements validated by the Joint Requirements Oversight Council (JROC) commensurate with available funding. The UAV EXCOM, with representation from the OSD, Joint Staff, Defense agencies, and the Services, maintains oversight and provides program direction. The UAV JROC Special Study Group is responsible for consolidating and reconciling requirements before presenting them to the JROC for approval. The UAV JPO confers with the Special Study Group to resolve requirements-related problems. The UAV Working Group conducts activities required by the UAV EXCOM. Chaired by the OSD, the Working Group includes representatives of each of the UAV EXCOM member agencies plus the National Security Agency (NSA), Defense Advanced Research Projects Agency (DARPA), UAV JPO, and other designated elements of OSD and Service staffs.

The UAV JPO is the central management authority for all DoD nonlethal UAV acquisition efforts (lethal UAVs are addressed in the Joint Standoff Weapons Master Plan), receiving its program guidance from the UAV EXCOM via the chain of command depicted in Figure 1. Composed of technical, business and program management personnel, the organization is responsible for planning and executing UAV development and acquisition programs. The JPO ensures that present and planned developments satisfy requirements validated by the JROC. Additionally, the JPO guides and coordinates appropriate UAV advanced technology that supports new, emerging requirements. The JPO is charged to maintain leadership in UAV system acquisition and to advocate UAVs as a significant warfighting advantage to operational commanders. Its objective is to field an affordable family of interoperable systems that optimizes commonality, is accepted by the Services, and is integrated into the DoD and Allied battle force architectures.

III. ACQUISITION STRATEGY AND INTEROPERABILITY AND COMMONALITY CONCEPT

A. ACQUISITION STRATEGY

UAV acquisition strategy is focused on fielding systems rapidly to meet operational requirements with common and interoperable systems. It includes:

1. Harmonizing operational requirements among the Services and Unified and Specified Combatant Commands.

2. Procuring off-the-shelf technologies for initial systems, thereby reducing cost, risk, and duration of development.

3. Developing specifications for systems after the Services have acquired hands-on operational experience. Operational experience is essential for reducing costs by providing users the basis for establishing specific performance specifications.

4. Conducting advanced research and development that enhances the systems' future capabilities. Advanced technologies are incorporated through block upgrades to the systems.

5. Maintaining all equipment interfaces, interface control documents, and specifications to ensure effective block upgrades and interchangeability of systems and subsystems.

6. Ensuring interoperability among all systems and subsystems with the command, control, communications, and intelligence (C^3I) systems of the Services.

7. Employing a competitive and evolutionary acquisition process to incorporate block upgrades to air vehicles, payloads, data links, mission planning and control stations, launch and recovery, and logistic support subsystems.

B. INTEROPERABILITY AND COMMONALITY CONCEPT

1. Objective

The modern battlefield abounds in complexity. Integration of systems to operate together has become as difficult, if not more so, as the development of the individual systems themselves. Joint operations demand that equipment of one Service perform effectively with those of other Services. This realization has engendered interoperability and commonality as the keystone elements of the UAV JPO acquisition strategy. UAV systems and subsystems must be interoperable. They must be able to operate effectively with the myriad of other C^3I systems. Commonality dictates that UAV systems have interchangeable components and/or similar and interchangeable characteristics so that investment and operating costs are minimized. Interoperability can be achieved without commonality, but commonality aids in ensuring that interoperability exists and helps to lower unit production costs.

2. Methodology

The UAV JPO has carefully crafted a five element methodology for achieving interoperability and commonality. It includes:

(a) UAV family architecture - The family architecture is the unifying concept and roadmap for the interoperability and commonality development process. The architecture is future focused accommodating both known and anticipated system performance requirements. It is the design concept and system definition for the family of UAV systems. It centers on identification, documentation, application, and control of key system interfaces called joint integration interfaces (JIIs). JII documentation provides a functional description and defines interface characteristics in sufficient detail (mechanical, electrical, software, etc.) so that system or subsystem interoperability is achieved if the interface requirements are met. The documentation effectively provides implementation for the CAPSTONE specification describing the family architecture. This specification has been distributed for initial review by government and industry. The resulting engineering design guidance for air vehicles is being prepared and the first JIIs are undergoing review prior to verification testing.

(b) Technology development - The JPO has collaborative initiatives with DARPA and the Services' technology organizations to identify and match technology efforts to UAV requirements. Efforts to avoid duplication and minimize investment cost while still satisfying UAV needs are ongoing. Only after these avenues are fully explored are unique UAV needs considered for funding.

(c) Technology transition - Products of development are evaluated and transitioned to operational systems through a systematic, iterative process that includes: direct transition of common core components to fielded or in-development systems; incorporation of block upgrades into fielded systems; insertion and validation of technology in user operational demonstrations; and evaluation in the family architecture at the Joint Technology Center Systems Integration Laboratory (JTC SIL).

(d) Family commonality - Commonality efforts strive to avoid duplication in development, achieve cost savings through larger production runs, and negate proliferation of different logistics support requirements. DoD developments and emerging standards are continuously surveyed and compared to UAV system needs to create a data base and design guide. This data base and design guide, along with adaptations from existing UAV programs and common core component developments, are used for future UAV system design. Common core component developments are designed to provide components and subsystems for all UAV categories and block upgrades and will be made available as preferred spares in existing systems. The first components under development include a heavy fuel engine, a common core avionics group, and a common automated recovery system.

The heavy fuel engine program will provide a light weight, high power density, fuel efficient, inexpensive engine for common application to the UAV family. Durable shaft powered engines that use reduced hazard military fuels such as JP-5, JP-8, and diesel will be designed, prototyped, and validated. The engine may meet the Short Range UAV Block II heavy fuel upgrade capability. The Naval Air Propulsion Center, Trenton, NJ has awarded contracts for three engine designs including rotary and two stroke engines. Engine testing commences in July 1991 and will be complete by February 1992.

Another commonality requirement is to specify and develop a low cost, modular avionics suite for the UAV family called the common core avionics group. The program, being managed by the Flight Control Division of the Wright Laboratory, Dayton, OH, includes:

(1) Specification development for a common package that includes flight control, inertial navigation and global positioning subsystems, and payload and data link management.

(2) Design, fabrication, and test of two development models.

(3) Transfer of the final product technology through an industry/government workshop.

(4) Delivery of development hardware for testing in July 1991.

The final commonality requirement, now being addressed, is for the design, development, fabrication, test, and demonstration of a common automatic recovery system. The primary purpose of the system is to automatically land a UAV. It will locate, track, and automatically recover UAVs on land and ship platforms in day and night and in all weather conditions. The system will be integrated into the maritime operational demonstration program and will use the CL-227 Sentinel vehicle as a test bed for integration and demonstration. The major system components are the portable recovery instrumentation subsystem (both ground and air units), the recovery control module, and their interfaces. The development and demonstration will support preparation of specifications for UAV family application.

(e) Operational demonstrations -These are conducted to involve field personnel early in the development process. Systems with new capabilities are placed in the hands of users to: help the JPO focus the efforts of government, industry, and engineering centers; validate the operational utility of mature technologies; and involve the user in technology transfer and requirements definition considerations. Ongoing and planned operational demonstrations are discussed in Section VI.

3. Joint Technology Center Systems Integration Laboratory (JTC SIL)

The JTC SIL, located at Redstone Arsenal, AL, is a laboratory that serves as the joint test bed or bureau of standards for the family of UAVs. It provides a means to perform simulation and test of integrated UAV hardware and software elements. Interoperability and commonality are validated, and hardware and software baseline configuration control of fielded systems is established. The JTC SIL performs independent verification and validation of resident UAV system software during the development phase of programs and provides post development software support to UAV program managers. The JTC SIL also provides a capability for industry to demonstrate the application of new equipment installed in existing UAV systems.

4. Joint Integration Interface Development Facility

The Joint Integration Interface (JII) Development Facility (JDF), located in the Washington, DC area, provides an engineering center to develop, verify, and document JIIs for system interoperability and, through use of a technology database, promote commonality within the UAV family architecture. The JDF provides effective simulation of system parameters using modular, flexible, and adaptive equipment designs. Further, it provides a capability for evaluating technology payoffs and technology investment strategies. The products are verified JIIs, technical documents, and specifications required for UAV system acquisitions.

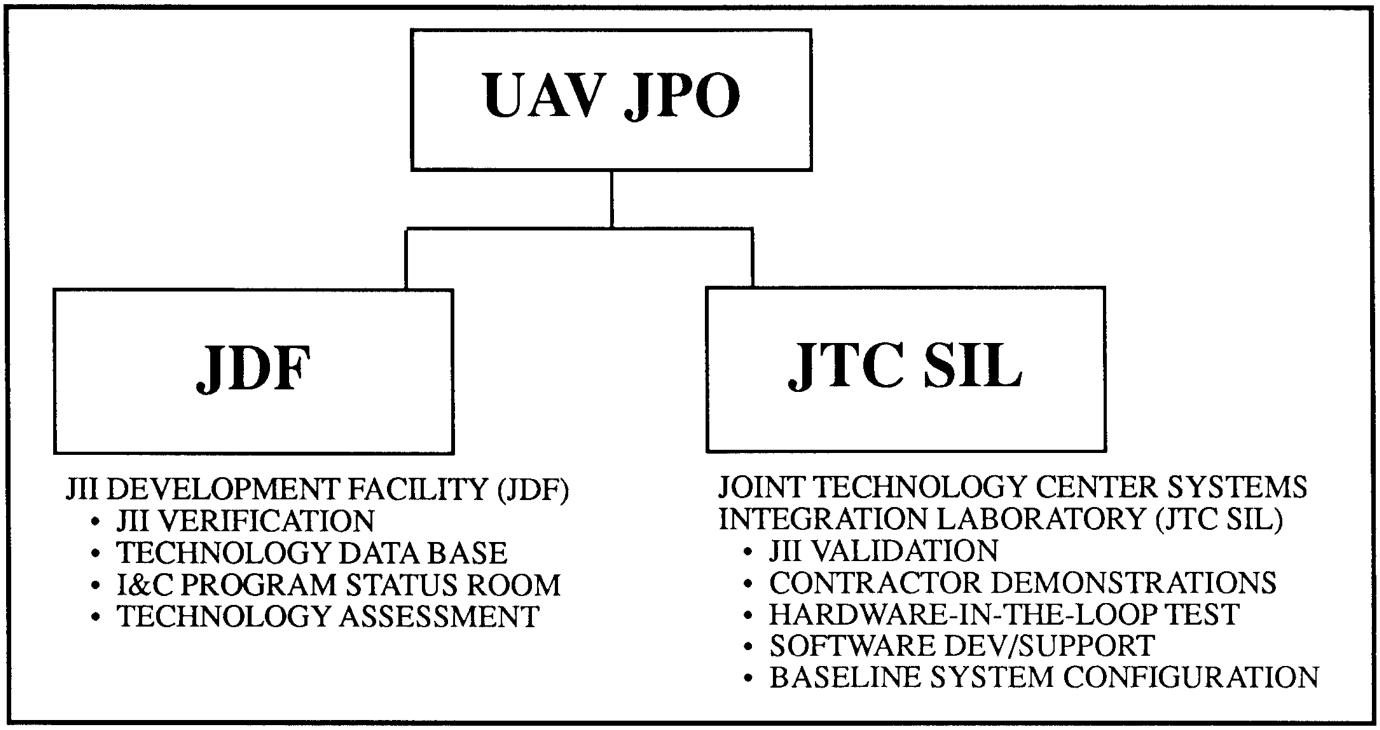


Figure 2 - Interoperability and Commonality Organization

Figure 2 illustrates the UAV JPO management organization for interoperability and commonality.

IV. MISSION NEED STATEMENTS, REQUIREMENTS CATEGORIES, AND FAMILY CONCEPT

A. MISSION NEED STATEMENTS (MNS)

	CLOSE	SHORT	MEDIUM	ENDURANCE
OPERATIONAL NEEDS	RS, TA, EW, MET, NBC	RS, TA, MET, NBC, C2, EW	PRE-AND POST-STRIKE RECONNAISSANCE, TA, SIGINT, EW, MET	RS, TA, C2, MET, NBC, SIGINT, EW, SPECIAL OPS
LAUNCH AND RECOVERY	LAND/SHIPBOARD	LAND/SHIPBOARD	AIR/LAND	LAND
RADIUS OF ACTION	50 KM	150 KM BEYOND FORWARD LINE OF OWN TROOPS	650 KM	CLASSIFIED
SPEED	NOT SPECIFIED	DASH >110 KNOTS CRUISE <90 KNOTS	.9 MACH	NOT SPECIFIED
ENDURANCE	3 HRS MINIMUM	8 TO 12 HRS	2 HRS	24 HRS ON STATION
INFORMATION TIMELINESS	NEAR-REAL-TIME	NEAR-REAL-TIME	NEAR-REAL-TIME/ RECORDED	NEAR-REAL-TIME
SENSOR TYPE	DAY/NIGHT IMAGING, EW, MET, NBC	DAY/NIGHT IMAGING, DATA RELAY, COMM RELAY, RADAR, SIGINT, MET, MASINT, TD, EW	DAY /NIGHT IMAGING, SIGINT, MET, EW	SIGINT, MET, COMM RELAY, DATA RELAY, NBC, IMAGING, MASINT, EW
AIR VEHICLE CONTROL	PRE-PROGRAMMED / REMOTE	PREPROGRAMMED/ REMOTE	PREPROGRAMMED	PREPROGRAMMED / REMOTE
GROUND STATION	VEHICLE & SHIP	VEHICLE & SHIP	JSIPS	VEHICLE & SHIP
DATA LINK	WORLDWIDE/LOW-HIGH INTENSITY	WORLDWIDE/LOW-HIGH INTENSITY	JSIPS INTEROPERABLE WORLDWIDE/LOW-HIGH INTENSITY	WORLDWIDE/LOW-HIGH INTENSITY
CREW SIZE	MINIMUM	MINIMUM	MINIMUM	MINIMUM
SERVICE NEED/ REQUIREMENT	ARMY, NAVY, MARINE CORPS	ARMY, NAVY, MARINE CORPS	NAVY, AIR FORCE, MARINE CORPS	ARMY, NAVY, MARINE CORPS

LEGEND:

C2 - COMMAND AND CONTROL

EW - ELECTRONIC WARFARE

JSIPS - JOINT SERVICE IMAGERY PROCESSING SYSTEM

MASINT - MEASUREMENT AND SIGNATURES INTELLIGENCE

MET - METEOROLOGY

NBC - NUCLEAR, BIOLOGICAL and CHEMICAL RECONNAISSANCE

RS - RECONNAISSANCE AND SURVEILLANCE

SIGINT - SIGNALS INTELLIGENCE

TA - TARGET ACQUISTION / TARGET SPOTTING

TD - TARGET DESIGNATOR

Figure 3 - UAV Mission Need Statement Summary

MNS for four categories of UAV capabilities (Close, Short, Medium and Endurance) have been validated by the Chairman of the JROC. Figure 3 provides a summary of UAV MNS required capabilities.

B. CATEGORIES OF CAPABILITIES

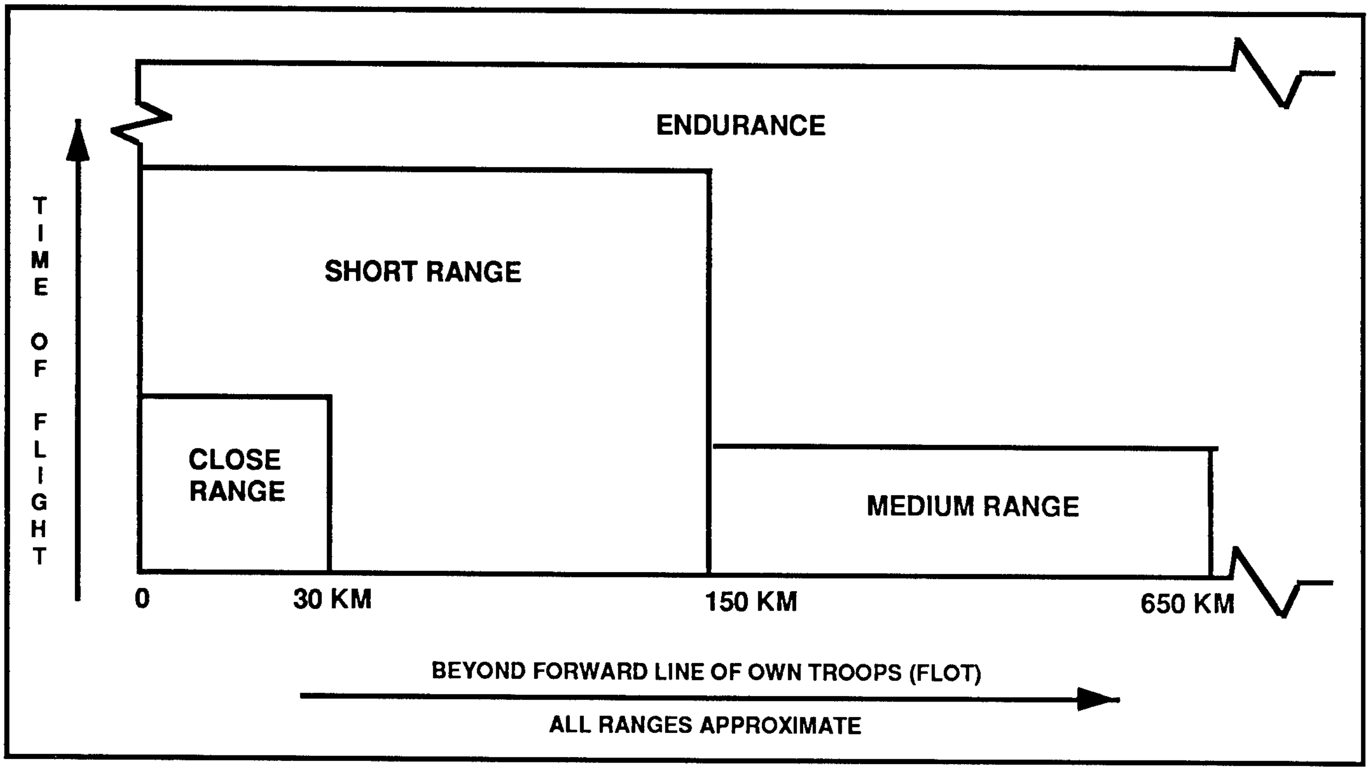


Figure 4 - Categories of Required UAV Capabilities

The categories of required capabilities, that are generally described by desired UAV system characteristics in the UAV MNS, are depicted graphically in Figure 4. The figure is a not-to-scale representation of time of flight in hours versus approximate range or radius of action in kilometers. Close Range capabilities address the needs of lower level tactical units such as Army brigades/ battalions, Marine Corps battalions/companies and Navy combatants for a capability to investigate activities within their local area of interest and influence. Systems must be easy to launch, operate and recover; require minimum manpower, training and logistics; and be relatively inexpensive. Short Range capabilities support Army division through echelons above corps level, Navy combatant, and Marine Air-Ground Task Force (MAGTF) level needs to cover enemy activities out to a range of 150 kilometers or more beyond the FLOT (forward line of own troops) or datum point (in naval operations). These UAV systems are more robust and sophisticated, can carry a wider variety of payloads, can consist of more than one air vehicle type, and can perform more kinds of missions than Close Range systems. Medium Range capabilities address the need to provide pre- and post-strike reconnaissance of heavily defended targets, and augment manned reconnaissance platforms by providing high quality, near-real-time imagery. They differ from other UAV capabilities in that the vehicle is designed to fly at high subsonic speeds and spend relatively small amounts of time over target areas of interest. Endurance capabilities respond to a wide variety of mission needs and address the capability to carry many types of payloads. Endurance systems are characterized by times of flight measured in days and very great ranges and altitudes of flight.

C. FAMILY CONCEPT

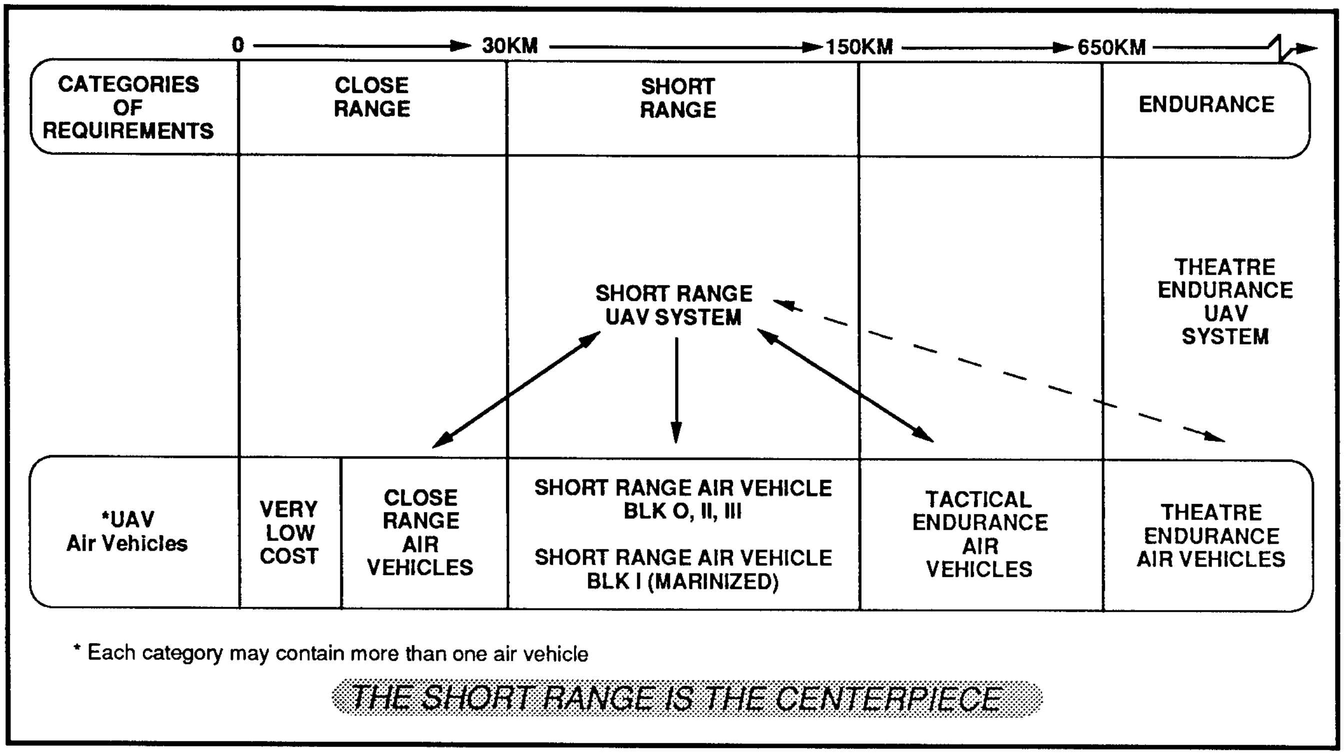


Figure 5 - UAV Family Concept

Establishment of a family of UAV systems that are interoperable and common is the core strategy of the UAV JPO. As Figure 5 illustrates, the Short Range system is the centerpiece of the strategy. It provides a baseline system capability that maximizes interoperability and commonality for Short Range Block I Maritime, Close Range, and tactical Endurance UAV systems. Due to its unique mission and its development start pre-dating the formation of the UAV JPO, Medium Range system interoperability and commonality is driven by the Joint Service Imagery Processing System (JSIPS) and the Advanced Tactical Air Reconnaissance System (ATARS) interface requirements rather than the UAV family concept.

V. UAV JPO PROGRAMS

A. VERY LOW COST

Very Low Cost (VLC) UAV systems exist to enhance knowledge of the utility of UAVs in battalion and sub-battalion tactical units (e.g., company, platoon, squad, and special operations team). They allow for operational experimentation that assists in requirements definition and refinement prior to procurement, and may provide an inexpensive capability that satisfies a portion of the Close Range mission need statement. VLC UAVs will improve reconnaissance, surveillance and target acquisition (RSTA) capabilities using low cost platforms with electro-optical; electronic warfare (EW); nuclear, biological and chemical (NBC) detection; and other payload experiments. They are very easy to launch, recover, and operate and require a minimum of operator maintenance and training.

The Marine Corps Research, Development, and Acquisition Command at Quantico, VA, is providing centralized management of the two current VLC operational experimentation programs: the FQM-151A Pointer and the BQM-147A Exdrone. Both are discussed in Section VI. In addition to the above projects, the VLC office will seek out and evaluate other VLC UAV vehicles/systems having military applications.

B. CLOSE RANGE

The development of specifications for the Close Range system will capitalize on experience from operational and developmental systems. VLC UAV evaluations by the Services of the Pointer system; Foreign Comparative Testing (formerly Foreign Weapons Evaluation) using the CL-227 Sentinel (Canada) and the Sprite and Raven (United Kingdom); and prior experience with the Pioneer, QH-50C Dash, Aquila, and the Marine Corps Airborne Remotely Operated Device constitute a significant data base. Employment and effectiveness data from these operational experiences will contribute to the definition of specifications for the Close Range system. These evaluations constitute the concept demonstration phase of the Close Range Program.

The Close Range system, comprised primarily of integrated off-the-shelf technology, will provide RSTA capabilities and meteorological data to commanders of lower level tactical units. Growth and block upgrades include: NBC detection, mine detection, EW, target spotting, target designation, and a communications relay capability. The Close Range system will meet the requirements of the Army and the Marine Corps.

The Close Range notional system consists of four air vehicles, each capable of employing one of several modular mission payload subsystems, a command and control system, data transmission system, navigation system, and on-board computer update capability; a ground based data station; a launch and recovery subsystem; and a ground support subsystem. The system must be highly mobile, easy to operate and maintain with a minimum of manpower and training, and capable of launch and recovery in constrained operational environments.

A high degree of interoperability and commonality with the Short Range system is required. The ground control station will be capable of operating either a Short Range or Close Range air vehicle to enhance warfighting capability. Commonality is desired to the maximum extent practicable to capitalize on inherent cost advantages in economies of scale and logistics support.

Short Range UAV hardware common to the Close Range system will be procured from the winning Short Range contractor and provided to the Close Range system integrator as government furnished equipment. The Close Range system integrator will provide the air vehicle and will perform systems integration to provide complete Close Range systems. Successful completion of developmental and operational tests will result in the exercise of options for production.

A risk reduction technology demonstration program for the Close Range system will be implemented during FY91 and FY92. This effort is intended to reduce both technical and schedule risk to the total Close Range program. Based on the nondevelopmental item acquisition strategy, Close Range Milestone I/II is anticipated in first quarter FY93. Milestone III will be sought in the first quarter FY97.

C. SHORT RANGE

The Short Range system is the developmental baseline for a common architecture to achieve interoperability within the family of UAVs. The acquisition strategy employs the baseline concept, involving the fielding and evaluation of an initial baseline configuration, followed by block upgrades to meet the full operational requirements. A modular approach, incorporating standard bus architecture, facilitates upgrades and provides a flexible baseline for other systems. The Short Range system takes maximum advantage of existing, off-the-shelf technologies.

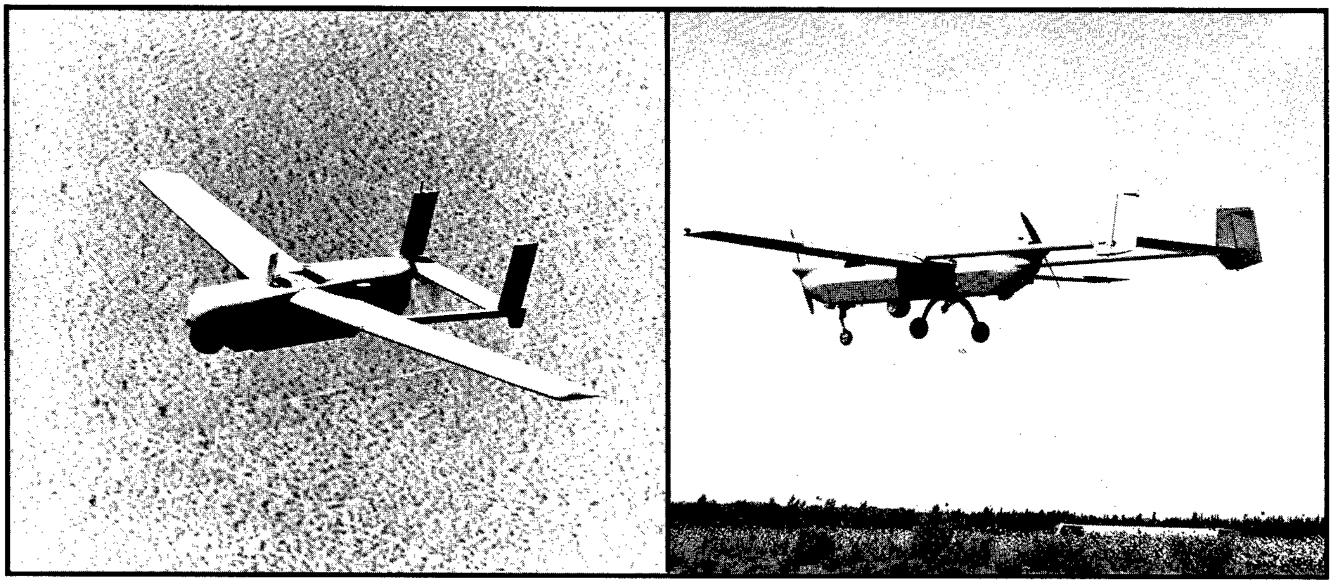
Short Range will provide commanders with near-real-time intelligence, reconnaissance, and battlefield surveillance. The air vehicle will operate at extended ranges forward of the FLOT and Navy datum points, day or night, and in limited adverse weather conditions. Short Range is intended for employment in Army corps and selected echelons above corps, MAGTFs, and from Navy ships in environments where immediate information feedback is needed, manned aircraft are unavailable, or excessive risk or other conditions render use of manned aircraft less than prudent.

The Short Range system consists of a mission planning and control station (MPCS) with two ground control stations and remote video terminals; multiple air vehicles; modular mission payloads; ground and air data terminals; launch and recovery equipment; and integrated logistics support.

The MPCS collects, processes, analyzes, and stores data and distributes battlefield information by interfacing with present/planned Service C^3I systems. Flight and mission commands are sent through ground data terminals to the air vehicles and modular mission payload from the MPCS. RSTA information and air vehicle position data are sent by downlink either through airborne relays or directly to the MPCS and external receiving systems. Mission data may also be recorded onboard the air vehicle to prevent loss during interruptions in the downlink data flow. Data received by the MPCS can be distributed to remote video terminals located in tactical operations centers. Missions are preprogrammed but may be changed while in flight. Mission capability will be enhanced as advanced mission payloads become available.

Acquisition of the Short Range system began with full and open competition in FY89. A draft request for proposal (RFP) was provided to industry in December 1988, followed by a formal RFP in March 1989. Contractors submitted proposals based on the award of a fixed price incentive contract for the production of two integrated Short Range systems for testing and not-to-exceed price options for three production lots in FY92, FY93 and FY94. On evaluation of the responses from industry, two firm-fixed price contracts were awarded on 15 September 1989 to McDonnell Douglas

Missile Systems Company and Israel Aircraft Industries, Ltd (see Figure 6). The contractors were allotted 18 months for fabrication and integration of their systems and delivery of complete Short Range systems and other associated hardware for Technical Evaluation Test and Operational Test IIA. Additionally, both contractors have submitted, as required, concepts for Short Range Block I and II upgrade improvements. Block I upgrades address the features necessary to achieve shipboard operation and are discussed in detail in the next section. Block II upgrades address a heavy fuel engine, an automatic tracking and area search capability, a manned surrogate trainer, and survivability enhancements.



McDonnell Douglas — Israeli Aircraft Industries

Figure 6 - Short Range UAVs

Prior to completion of the testing phase the contractors will submit: firm-fixed price proposals for the three production lots; firm-fixed price proposals for design, fabrication and test of Blocks I and II; and not-to-exceed price proposals for Block I and II production. Based on evaluation criteria of cost, technical characteristics, logistics, and management, a down-selection to a single contractor will occur and a MS IIIB (low rate production decision) will take place. After MS IIIB, an Operational Test IIB will be conducted on production representative equipment prior to a MS IIIC full rate decision. The residual assets from the system not selected for low rate production may be used for a contingency mission role.

The Short Range system has an ambitious acquisition strategy: to maximize competition, make use of off-the-shelf technology, draw from lessons learned in previous UAV experience, and progress from Milestone 0 to full rate production in less than four years. The compressed nature of this acquisition program is best exemplified by its progression from Milestone 0 through Milestone II/IIIA and the award of two initial production contracts in a seven month period. In recognition of this accomplishment, the Secretary of the Navy presented the UAV JPO with the Action Plus Excellence Award for Acquisition Streamlining.

D. SHORT RANGE BLOCK I

The Chief of Naval Operations (CNO) has defined distinct requirements for a Maritime UAV for surface combatants as well as aircraft capable ships. These requirements are set forth in a tentative operational requirement (TOR) for a surface combatant battle space expansion capability that defines payload, system characteristics, manpower requirements, and ship types, as well as requirements for integration of this capability within the C^3I and work station architecture of the host ships. The constraint of limited deck space for launch and recovery indicates a need for a VTOL air vehicle.

The UAV JPO has initiated activities to develop and procure a UAV capability, integral to surface ship combatant systems, that will provide: over-the-horizon classification; targeting and battle damage assessment; off-board ship self defense; and communication/data relay capability. These activities include: preparation of a development options paper (DOP) using industry and government inputs and trade-offs solicited at an industry brief conducted in October 1990; initiation of a concept of operations (CONOPS) for use in wargaming; and assistance to CNO in conducting a force level analysis for defining the quantities of Maritime UAVs required to satisfy the mission scenarios, requirements definition/validation, and technical risk reduction.

The acquisition strategy for the Maritime UAV leverages from the existing Short Range program, from participation in NATO Project Group 35 on a common Maritime UAV, and from ongoing UAV JPO technology efforts related to common core avionics, automatic launch/recovery systems, and heavy fuel engines. In addition, interoperability and commonality definition and operational experimentation with the Maritime Vertical Takeoff and Landing Unmanned Aerial Vehicle System (MAVUS) will reduce risk for the program and provide baseline data for defining the Maritime UAV.

The requirements and approach for developing a Maritime UAV capability were initiated as part of a Block I upgrade study to the Short Range UAV system. The Block I study was to define the concept and approach for adapting the Short Range UAV systems discussed in prior Section V.C. for shipboard operations. Each of the Short Range UAV system contractors prepared a study to provide shipboard compatibility details for the employment of the Short Range on battleships, amphibious assault ships, and other combatants in a permanently installed manner. Ship modification assessments were focused on how the Short Range systems could be adapted for installation on small combatants and battleships as a replacement for the Pioneer UAV system. Contractors were given the option to use alternative air vehicles. However, the Department of the Navy decision to decommission the USS Iowa and USS New Jersey, and the possibility of decommissioning the remaining two battleships, has refocused the surface warfare requirement for UAVs to smaller surface combatants. As a result, alternative air vehicle designs must be considered for launch and recovery from small deck spaces, and UAV system ground elements must make use of existing antennas, maintenance and support facilities, manpower, and command and control consoles. Concurrent with the Block I study the UAV JPO is defining air vehicle and mission planning and control JIIs under the interoperability and commonality program. The winner of the Short Range down-select in FY92 will have unique system interfaces that will be harmonized with the UAV JPO JIIs. These harmonized interfaces will be evaluated for compatibility with combatant ship C^3I and work station structure. At the down-select the winning contractor's software and hardware will also be defined and can be evaluated for ship compatibility. In addition, the feasibility of integrating UAV command and control into evolving battle force systems engineering architecture under development by the Naval Space and Warfare Command is being evaluated.

The results of the Short Range Block I (Maritime UAV) studies submitted by the Short Range UAV contractors, the development of the DOP for alternative maritime concepts/approaches, and the UAV JPO technology and feasibility efforts being conducted will provide the basis for initiating full scale engineering development (FSED) when funding is provided. It is anticipated that several mature or maturing technologies in VTOL (i.e., tilt-wing/tilt-rotor, ducted fan air vehicles, and other innovative air vehicle concepts for launch and recovery from small deck areas) will provide a competitive base for Maritime UAV FSED contract competition. Any growth for additional payloads or air vehicle requirements for extended performance will be addressed as block upgrades to the baseline system configuration.

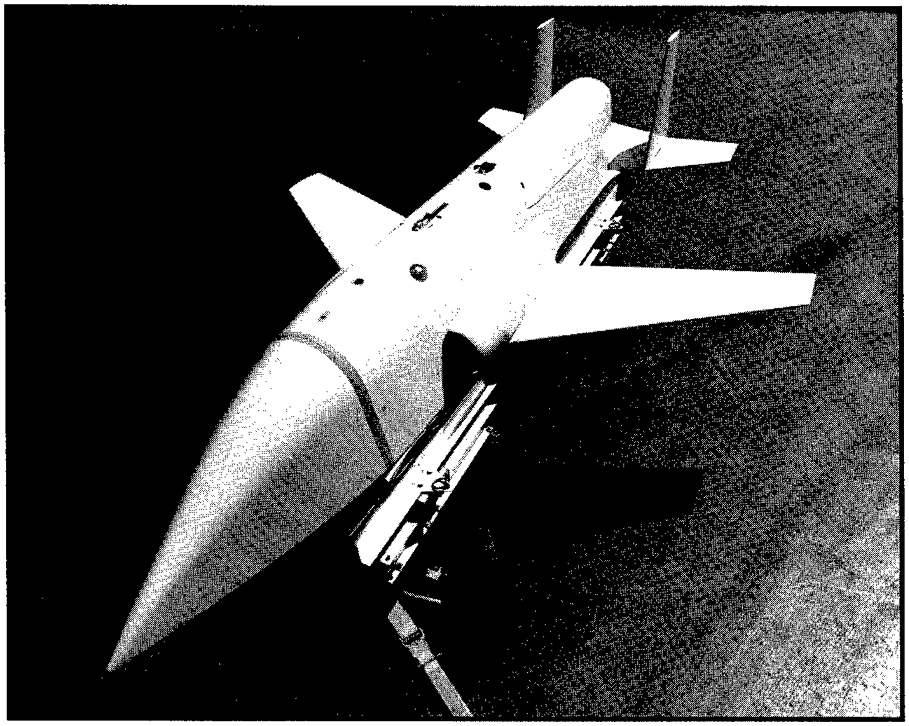
E. MEDIUM RANGE

The Medium Range UAV system is being developed to perform Navy, Marine Corps and Air Force reconnaissance missions in the late 1990's and beyond. It will provide a quick response capability to obtain high quality imagery in low and high threat environments.

The Medium Range is a complementary asset to manned tactical reconnaissance. It is a small profile, high-speed, fully autonomous vehicle that is capable of air and ground launch. The system provides multi-mission support to the C^3I operations of Carrier Battle Groups, Battleship Surface Action Groups, Amphibious Ready Groups, MAGTFs, and Tactical Air Force Units, with target acquisition and battle damage assessment being two of its primary missions. The multi-theater role supports warfighting operations under most weather conditions, during either day or night.

The Medium Range UAV, designated BQM-145A (see Figure 7), is derived from the Teledyne Ryan Aeronautical Model 324 UAV currently in production for the Egyptian government. The BQM-145A is smaller, faster, and capable of higher performance than the Model 324. The system is composed of the air vehicle, air and surface launch support hardware, low altitude electro-optic/infrared sensor payloads, recovery equipment, and ground handling and test equipment. The air launch platforms are the F/A-18 (C/D) and RF-16. The ATARS sensors are being developed for Air Force, Navy, and Marine Corps reconnaissance platforms. These digital sensors provide better quality imagery and are more timely than the current film-based cameras used in today's tactical reconnaissance platforms. The ATARS sensors are capable of transmitting collected imagery in near-real-time via data link and will also store imagery on tape which deletes the requirement for large quantities of water and expensive chemicals. Provisions for alternative non-imaging payloads are being examined. Mission planning for the BQM-145A employs the Tactical Aircraft Mission Planning System (TAMPS) for the Navy and Marine Corps, and the Mission Support System (MSS) for the Air Force. Imagery processing and data exploitation are performed utilizing the JSIPS. An alternate recovery concept using a Mid-Air Recovery System (MARS) is planned to more effectively meet the Navy requirement for a dry recovery at sea.

The development and procurement of a Medium Range system were directed by the Secretary of the Navy in July 1985, and in May 1986 an acquisition plan was approved. The acquisition strategy emphasized harmonization of Service requirements and the interoperability, commonality, and standardization of system hardware, software, training, and integrated logistics support. Upon creation of the UAV JPO, operational requirements of the individual Services were consolidated into a joint mission need statement approved in June 1989.



Teledyne Ryan Aeronautical

Figure 7 - Medium Range UAV

The UAV JPO conducted a competitive procurement and in June 1989 awarded a fixed price incentive contract for full scale development to Teledyne Ryan Aeronautical for fabrication, integration, integrated testing, and demonstration of the Medium Range system. Decisions were made to delete the A-6E and RF-4 and to include the RF-16 as an air launch platform, the Mode 4 IFF (identification, friend or foe), and the P-Code (encrypted) GPS (global positioning system). Based on reliability and maintainability concerns, a change from a composite airframe to a metallic structure is required. A Medium Range program restructure to address this and other issues is in process. An alternative that proves to be most cost-effective and best serves Service needs will be selected and presented to the UAV EXCOM in April 1991 for approval.

F. ENDURANCE

Systems(s) satisfying the requirements for an Endurance category UAV are managed by the Defense Support Project Office.

VI. FIELDED SYSTEMS/OPERATIONAL DEMONSTRATIONS

A. PIONEER

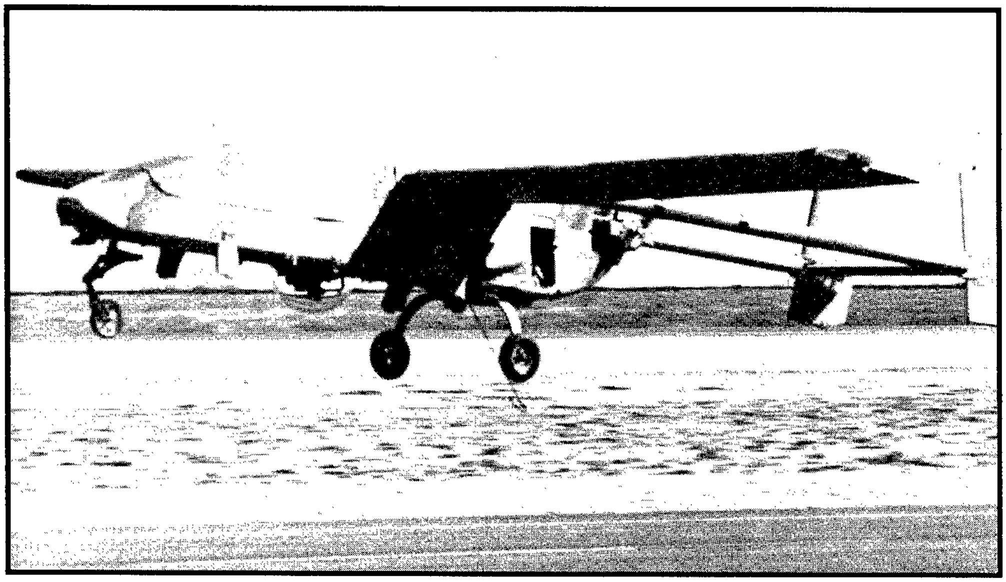


Figure 8 - Pioneer

The Pioneer system provides near-real-time RSTA, target spotting, and battle damage assessment within line-of-sight of the ground control station, day or night (see Figure 8). Pioneer is employed from field positions, battleships, or amphibious ships. A Pioneer system consists of five air vehicles, a ground control system, a portable control station, two remote receiving stations, and pneumatic or rocket assisted launchers. A Pioneer system is transported using two five-ton trucks and two High Mobility Multipurpose Wheeled Vehicles (HMMWVs) with trailers. Pioneer air vehicles are capable of operating for up to five hours with either day television or night forward looking infrared sensors. Pioneer flies between 1,000 - 13,000 feet above sea level, 60 - 95 knots, and up to 220 kilometers from a ground control station. The air vehicle is driven by a pusher propeller and powered by a two cylinder engine using aviation gas. DoD has received the inventory objective of nine Pioneer systems: five systems for the Navy, three for the Marine Corps and one for the Army. Pioneer flight operations require about 20 personnel.

The system provides an operational capability, and also is available for evaluation of UAV hardware, software, operational concepts, doctrine, and tactics. Pioneer is used by Navy, Marine, and Army personnel to define UAV system performance requirements. Navy Pioneer operations over the past year supported battleship missions of target surveillance, gunnery spotting, and battle damage assessment. Land based Pioneers supported ground units with artillery adjustment, route reconnaissance, and surveillance. The system confirmed surface ship locations during day and night by providing initial detection and positive confirmation of radar detection.

Through October 1990, Pioneer systems have flown 4358.3 flight hours and made 2232 flights. Pioneer has operated from four battleships during five deployments supporting world wide operations in Africa, Northern Europe, the Northern Atlantic, Korea, the Mediterranean Sea, and contingency operations in the Persian Gulf. Ground units have supported Weapons and Tactics

Instruction (WTI) and Kernal Blitz exercises as well as supporting the U.S. Customs Department in drug interdiction missions. Currently, three Services are operating Pioneer in support of Operation Desert Storm. Pioneer is scheduled to operate through FY98. Management of logistics, training, and test support for the Pioneer systems remains the responsibility of the Navy.

B. CL-227 MARITIME VERTICAL TAKEOFF AND LANDING UNMANNED AERIAL VEHICLE SYSTEM (MAVUS)

The CL-227 UAV system includes a small, compact rotary-winged air vehicle capable of VTOL, hover, and forward flight (see Figure 9). The air vehicle carries modular mission payloads weighing up to 100 pounds and flies at speeds from hover to 70 knots. Advertised range is 60 kilometers, maximum attainable altitude is 10,000 feet and flight endurance is 3 hours, depending on payload weight. CL-227 offers growth potential for greater range, endurance, airspeed, payload capacity, and autonomous navigation. A typical operational system comprised of four air vehicles, data link, ground control station (GCS), and portable power supply, requires six to eight personnel to operate and maintain. An operational system can be transported to the battlefield by a variety of helicopters. Additionally, a system may be ground mobile, deployed with three HMMWV's and trailers, or ship based. The air vehicle (nicknamed "Peanut" because of its shape) has a modular body (three modules) which is 5.5 feet high, has a rotor diameter of nine feet, and has a maximum takeoff weight of 440 pounds. CL-227 is manufactured by Canadair, Inc. (a subsidiary of Bombardier, Inc.) of Montreal, Canada.

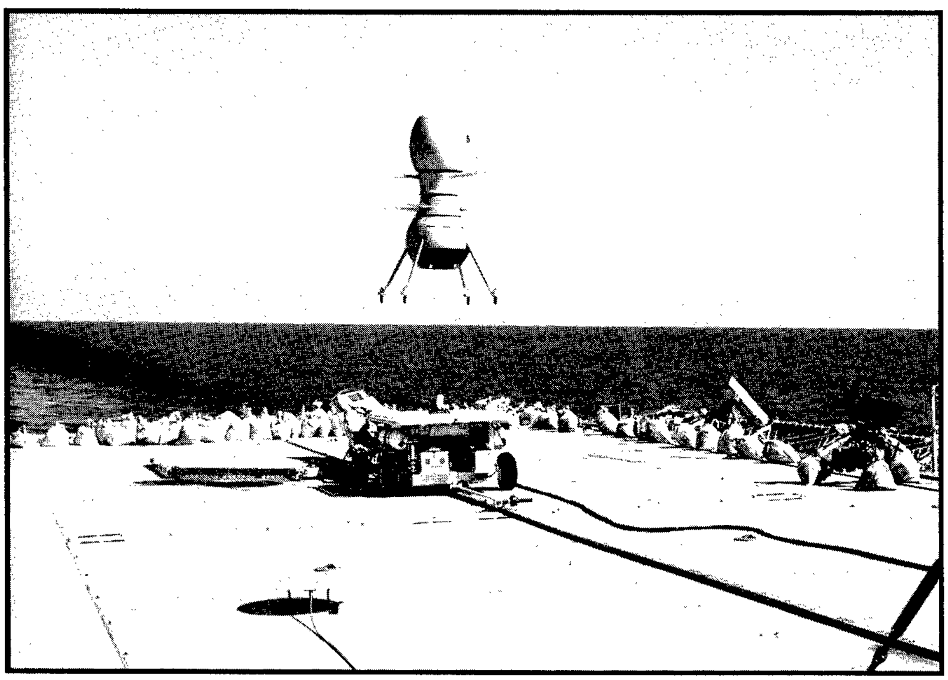


Figure 9 - CL-227 (MAVUS)

The U.S. and Canadian Governments have established a project agreement under the defense developmental sharing agreement (DDSA) for the development, test and evaluation of a CL-227 onboard a U.S. naval combatant. The CL-227, called MAVUS, is funded through the foreign

comparative test (FCT) program. The MAVUS program will provide the U.S. Navy with the ability to evaluate the operational utility of UAV systems on small combatants; define the costs and benefits associated with employment of UAVs in the at-sea operational environment; develop mission roles and tactics; and evaluate the ability of existing ship's crew to operate VTOL UAV systems as an adjunct to their existing duties. MAVUS will deploy on the U.S.S. DOYLE (FFG-39) with the Standing Naval Force Atlantic (STANAVFORLANT) in June-December 1991. Approximately 120 flight hours will be flown to achieve the program's objectives. The members of NATO Project Group 35 (Canada, Germany, the Netherlands, Norway, the United Kingdom, and the U.S.) are all participating in the MAVUS project. Canada, the Netherlands, and the United Kingdom will equip ships which will be assigned to STANAVFORLANT with the capability to receive imagery from the MAVUS. The Canadian ship will also be able to control the CL-227 air vehicles after they have been launched from the DOYLE. Norway and Germany will contribute test data reduction and operational analysis support to the project. The MAVUS system includes: four Canadair CL-227 Sentinel VTOL air vehicles; day/night imaging, radio relay and EW payloads; an integrated MPCS with enhanced imagery exploitation capability; an integrated ship mounted dual antenna data link system; an independent launch and recovery system; and full logistics support. Crew members from the DOYLE will be trained in system operation at the Canadair factory in Montreal, Canada, and will complete flight training on the system at the Naval Air Engineering Center in Lakehurst, NJ. System installation will be accomplished in the DOYLE's home port, Mayport, FL.

C. FQM-151A POINTER

FQM-151A Pointer is a very low cost, hand-launched, battery powered UAV (see Figure 10). Presently a fixed, black and white day television camera is the only available payload; however, a color television capability is in development to support counternarcotic operations. Pointer is backpackable in hard-shell containers attached to military issue fieldpack frames. The air vehicle container weighs 45 pounds; the ground control unit (GCU) weighs 50 pounds. A new soft backpack for the air vehicle will weigh 23 pounds and be air-droppable in parachute operations. The GCU controls the air vehicle, displays and records air vehicle video imagery, and records narrative provided by a ground observer. The air vehicle is quickly assembled from six sections, has a nine foot wingspan, and is six feet long. Launch weight is presently nine pounds with new replacement air vehicles a pound less. Recovery is executed by a deep-stall maneuver to a soft landing in a flat attitude. Pointer can be prepared for launch in less than five minutes by two personnel. The air vehicle presently has a range of five kilometers and a flight duration in excess of one hour. A forthcoming upgrade increases range to 10 kilometers. Optimal operating altitude for the air vehicle is typically 200 to 500 feet above ground level. One Pointer system normally includes four air vehicles and two GCU's.

The mission of Pointer is reconnaissance and surveillance for lower-level ground combat units (e.g., infantry companies/battalions) within their local areas of responsibility. Operational results with Army and Marine Corps units indicate that Pointer is both simple and safe to operate and rapidly deployable with tactical units via surface or air transport. Only brief orientation training is required to qualify Pointer system operators. No unique educational background, formal school training, extensive military experience or uncommon physical skills are required. User evaluation indicates that Pointer enhances mission performance, assists in tracking friendly and enemy troops,

and provides timely and useful battlefield information. The system also generates unique information easily integrated with other intelligence sources. Currently, Pointer is limited to daylight operations; however, a night capability using night vision goggle components is feasible. High/gusty wind conditions and masking terrain also tend to limit system employment.

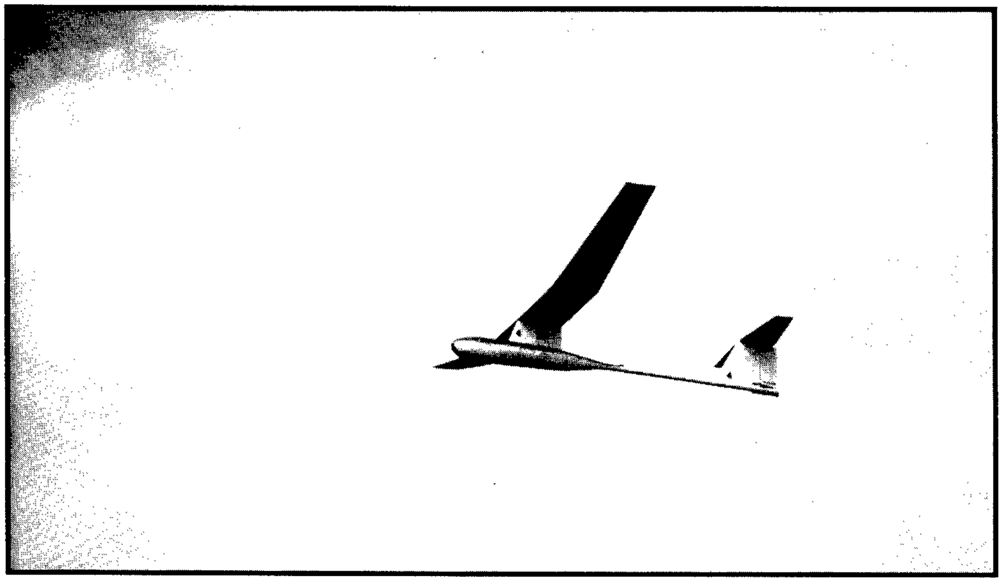


Figure 10 - Pointer

Six Pointer systems were procured and delivered in 1990 for operational experimentation with units of the Army and Marine Corps. Logistics support and technical assistance are provided by the Pointer's designer and manufacturer, AeroVironment of Simi Valley, CA. Logistical support for deployed Pointer systems terminates in the first quarter FY92 unless extended.

The Program Executive Officer Quality Management Award was presented to AeroVironment in February 1991 to recognize their superb quality efforts during 1990.

Pointer has been evaluated by the 2nd Infantry Division, 25th Infantry Division (Light), 7th Infantry Division (Light), 82nd Airborne Division, 8th Marine Regiment, 7th Marine Expeditionary Brigade, and the Drug Enforcement Administration. Five of six systems are currently deployed in Operation Desert Storm with the 82nd Airborne Division, First Marine Expeditionary Force, and 4th Marine Expeditionary Brigade. One system resides with the Army's 25th Infantry Division (Light) in Hawaii. Additional Pointer systems may be procured to support Operation Desert Storm. An interim report on Pointer usage is available upon request from the UAV JPO public affairs office.

D. BQM-147A EXDRONE

The FY91/92 operational experimentation by field users will employ the Exdrone with a daylight, color television camera that is well suited for reconnaissance and surveillance missions close to operating forces. In addition to the camera, the vehicle can carry other payloads such as jammers or electronic sensors. Exdrone prototype models (see Figure 11) were flown by the Naval Air Test Center, Patuxent River, MD between October 1990 and January 1991 to further define production specifications. The Exdrone has a range of 25 miles, endurance of greater than two hours, maximum speed of 87 knots, maximum weight of 80 pounds with payload, and can be launched by bungee or rocket assisted take-off (RATO).

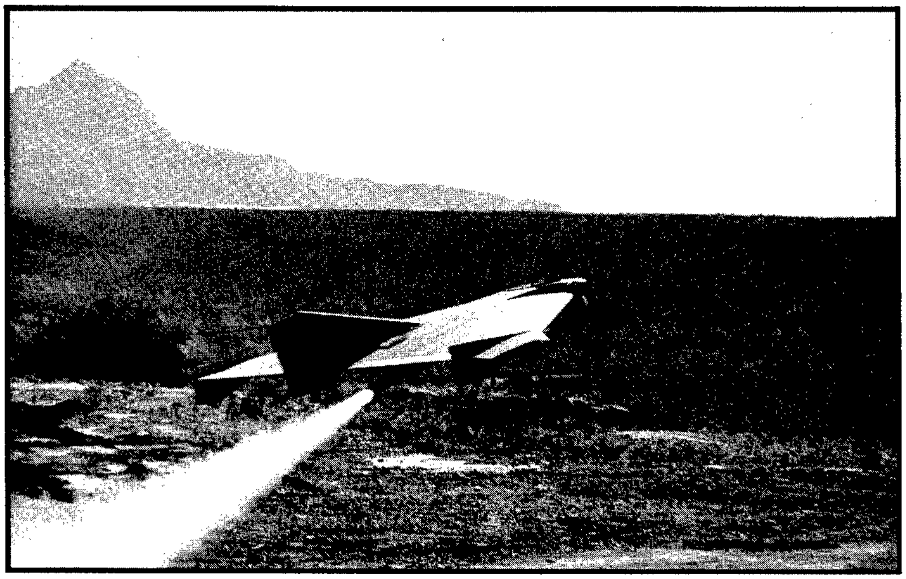


Figure 11 - Exdrone

VII. FOREIGN COMPARATIVE TESTING (FCT)

A. SPRITE

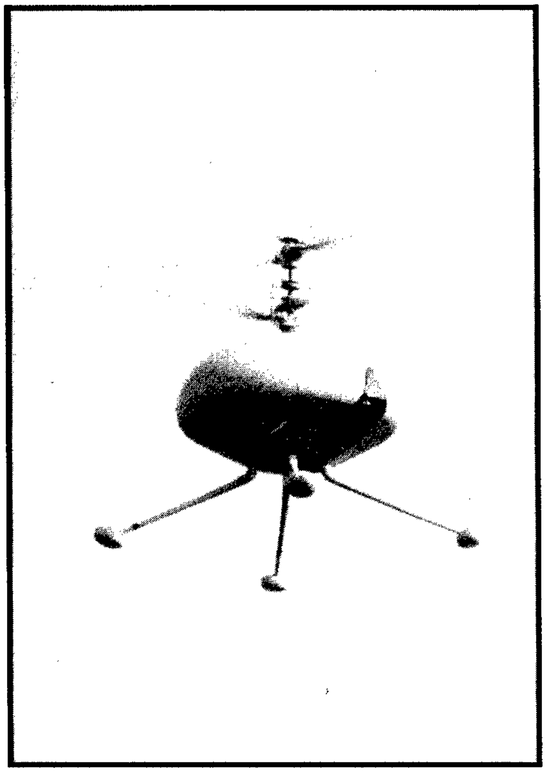


Figure 12 - Sprite

Sprite is a VTOL UAV system in the Close Range requirements category (see Figure 12). The system's ability to hover makes it useful in situations where fixed wing UAVs are not practical. The system, comprised of an air vehicle and a ground control station, and two operators are transported in a single ground vehicle (i.e. a HMMWV with trailer). The air vehicle has a spheroidal, four quadrant (i.e., propulsion, fuel storage, avionics, and payload) modular body which measures three feet high with a diameter of 2.1 feet and rotor diameter of 5.2 feet. With a maximum launch weight of 88 pounds, the air vehicle is easily carried by two individuals. Sprite is propelled by counter rotating blades powered by two six-horsepower, two cycle reciprocating engines. One engine is adequate for hover capability. Sprite has an advertised top speed of 60 knots, operating radius of 25 kilometers, and two hour flight endurance. Sprite's modular design contributes to the ease of maintenance as well as the use of alternate payloads including: imagery sensors (black and white/ color/low light level television and forward looking infrared); and NBC sensors.

Sprite is manufactured by M.L. Wallop Defence Systems Ltd. of the United Kingdom. FCT was conducted from May through September 1989 in the U.S. Testing included a NATO ship compatibility demonstration during May 1989 in the Gulf of Mexico on a 210 foot Coast Guard cutter. Testing was also conducted by the Army and the Marine Corps for ground combat missions and by the Air Force using Sprite as a sensor platform for airfield damage assessment. The results of the limited testing concluded that Sprite, as a preproduction system, was an immature system in that reliability or maintainability were major limitations to the completion of planned testing. A test report on the Sprite FCT is available at the UAV JPO.

B. CL-227

The CL-227 successfully completed a U.S. Army shipboard demonstration in conjunction with the small aerostat surveillance system (SASS) in August 1989. Joint U.S.and Canadian Army and Air Force evaluation of the land version CL-227 was conducted during July 1989 through February 1990. This testing included phases at Suffield (Alberta, Canada), Holloman AFB, NM, and Ft Huachuca, AZ. It is now in a phase of tactical design, demonstration and evaluation which will include the MAVUS operational demonstration discussed in Section VI.B.

C. RAVEN

Raven is a UAV system in the Close Range requirements category. The system combines both useful performance and simplicity of operation. The Raven air vehicle is easily assembled for flight from major subassemblies by a three man crew. The air vehicle measures 12 feet in wingspan and 10.5 feet in length. It has a normal take-off weight of 169 pounds and is powered by a single two-stroke, 1400cc gasoline engine. Maximum payload weight is 33 pounds. The towed catapult launcher is bungee powered and provides a convenient storage space for three air vehicles, ground support equipment, spare parts, and consumables. Recovery of the air vehicle is via skid landing or parachute. The Raven air vehicle has a speed range of 40 to 110 knots and is stabilized in three axes to provide a steady viewing platform for imagery payloads. Either an infrared imager with selectable fields of view or a day and low light, black and white television camera with a zoom lens may be selected for a mission.

One Raven system was procured from Flight Refueling Ltd. of the United Kingdom for evaluation by the Army under the FCT program prior to formation of the UAV JPO. This system included both hardware and contractor logistics support for technical and operational testing conducted at Fort Huachuca, AZ. FCT testing accumulated nearly 70 flight hours in 46 missions. Maximum operating range achieved was 50 kilometers and maximum flight duration was in excess of two hours. Raven equipment has been refurbished and stored at Ft. Huachuca, AZ. A test report on Raven FCT testing is expected to be available in the third quarter FY91.

VIII. ANALYSIS AND SIMULATION

The UAV EXCOM directed preparation of a cost and operational effectiveness analysis (COEA) for the family of UAVs. Its purpose is to determine the cost and utility of UAVs compared to other alternatives and to determine the additional value of UAVs in the Services' force structure. The COEA follows the guidelines established by OSD and is structured to support the milestone decision points of the UAV Master Schedule, Appendix A. A steering group composed of representatives from OSD, the Joint Staff, the Defense Intelligence Agency, the Services, and the UAV JPO has been established to guide and review the COEA while in progress. The COEA is being performed by an independent study team directed by the Center for Naval Analysis.

The study team recently completed Phase I of the COEA. Phase I addressed the broad issue concerning the presence of UAVs in the Defense portfolio. A corollary objective was to determine the right family of UAV types for development. Phase I efforts began with a broad survey identifying "high potential payoff" Service missions suitable for UAVs. Seventeen specific missions were then selected as case studies. Each case study was a COEA for a specific mission. The results of the case studies were integrated to identify common themes and major issues that relate to the composition of the UAV family.

The Phase I results show that UAVs belong in the Defense portfolio and are almost certainly more cost-effective than the alternatives for performing many important missions under at least some conditions. Results were not as definitive concerning the composition of the UAV family. Uncertainties about specific UAV costs, levels of survivability, and achievable usage rates inhibited firm conclusions and recommendations concerning the UAV family composition. These concerns are being addressed in a Phase II effort that is now underway.

The UAV JPO has established, and is executing, a comprehensive UAV survivability plan that will permit credible, quantitative evaluation of the survivability potential of UAV system configurations, modifications, and proposed improvements. The plan addresses standardized methods for threat analysis; air vehicle, data link, and GCS susceptibility and vulnerability determinations; and air vehicle/threat weapon encounter simulation analysis. Methods for system survivability improvement, such as radar absorbing materials, redundant critical subsystems, threat avoidance flight profiles, and vehicle augmentation with radar warning receivers and towed decoys, are being explored. The Survivability Information and Analysis Center (SURVIAC), Dayton, OH, DoD's recognized leader in aircraft and weapon system survivability expertise, is the UAV JPO's agent for plan execution. They are providing expertise and assistance to the Phase II COEA effort, and to system survivability working groups that have been established for the Short Range and Medium Range UAV programs.

Supplementing the COEA and survivability efforts, the JPO has been proactive in introducing UAVs into various existing wargames and simulations. Simulations at the Naval Surface Warfare Center,White Oak, MD are being used to investigate employment methods and proposed capability trade-offs for a Maritime UAV. Additionally, employment of UAVs in interactive video simulations such as the Army's SIMNET enhances user awareness of UAV value on the battlefield. Gaming and simulations also serve as a "line-check" of more detailed analysis efforts, assist in requirements and operational concepts definition, provide hands-on, man-in-the-loop training, and offer much lower cost alternatives to expensive developmental hardware testing.

IX. ADVANCED TECHNOLOGY

In collaboration with DARPA and in coordination among a wide variety of DoD laboratories and development agencies, the UAV JPO has developed an advanced technology program. This program addresses technologies needed to ensure future UAV mission utility, survivability, supportability, and cost-effectiveness. The program forms a roadmap of not only technology maturation timeframes, but also timelines for fielding, block upgrades, or replacement of various UAV systems. The five major categories of technology issues the JPO will be focusing on are: air vehicle (airframe, propulsion, launch and recovery), avionics, payloads (sensors and electronic warfare systems), data links, and man-machine interface (mission planning and control station and human factors engineering). They are documented in the UAV Advanced Technology Plan, which has been coordinated with the Services through the UAV Joint Technology Steering Committee (JTSC) and approved jointly by the UAV JPO and DARPA. The JTSC is composed of representatives of the UAV JPO, DARPA, NSA, and the Services' technology organizations. It provides a focal point for coordinating and managing UAV related technology development efforts throughout the DoD.

Figure 13 provides a summary of on-going UAV technology efforts within the DoD. The majority of efforts are Small Business Innovation Research (SBIR) activity. These efforts are managed by DARPA and the Service technology organizations. The heavy emphasis on SBIR projects and other funding sources, e.g., the Balanced Technology Initiative (BTI), reflects the current lack of specific resourcing for advanced technology within the UAV JPO. Two major projects from Figure 13 that warrant special mention are: the UAV Moving Target Indicator (MTI) radar and the Battalion Targeting Sensor (BTS) demonstration.

The Army Laboratory Command (LABCOM) at Adelphi, MD, in conjunction with DARPA and MIT Lincoln Laboratories, has sponsored the development of a small UAV MTI radar. The 110 pound unit, which will track moving ground vehicles and helicopters, has been tested at Fort Devens, MA and Fort Sill, OK. An advanced technology transition demonstration of this system is currently underway. The technology barrier to be overcome in this program is the combining of high speed, programmable, state-of-the-art signal processors and data processing technology in a package that meets UAV size, weight, and power constraints.

The LABCOM Advanced Systems Concept Office at Fort Meade, MD, is conducting the BTS demonstration as part of the BTI, a DoD program with a goal of speeding the introduction of advanced technology into weapons and equipment. This demonstration will show the capability of using multiple sensors, along with information fusion and displays, at the battalion level to improve weapon targeting capabilities, situation assessment, and operations planning. One or more of the sensors will be demonstrated on an elevated platform. The BTS demonstration will focus on sensors and processing/fusion software algorithms for integration of data from multiple sources. UAV JPO assets will be used, where appropriate, to facilitate the demonstration and provide a natural transition for the products of the BTS program.

TECHNOLOGY AREA	DARPA	NAVY	ARMY	USAF
AIR VEHICLE	SLAVED TANDEM FREEWING (1) MANUFACTURING TECH. (1)	LOW ALTITUDE/AIRSPEED UNMANNED RESEARCH AIRCRAFT - NRL TIPJET - DTRC LIGHTWEIGHT RPV ENGINE ALTERNATOR/STARTER - NAPC (1) UAV PROPELLER LOAD CONTROL - NAPC (1) UAV PROPELLER EROSION PROTECTION - NAPC (1) INNOVATIVE SMALL ENGINE CONCEPTS - NAPC (1) HIGH ENERGY DENSITY SECONDARY BATTERIES - NAPC (1) UAV PROPULSION SYSTEM HEAT EXCHANGER TECH - NAPC (1) INNOVATIVE UAV VTOL PROPULSION CONCEPTS - NAPC (1) INNOVATIVE UAV ENGINE NOISE SUPPRESSION CONCEPTS - NAPC (1) HIGH SPEED DIESEL FUEL INJECTION TECHNOLOGY - NAPC (1)		DUCTED FAN TECHNOLOGY DEMONSTRATORS - WL (1)
PAYLOADS	ENVIRONMENTAL SENSORS (1) ANTI-ICING (1) MULTI-SENSOR MGMT TECH FOR A HIGH ALTITUDE LONG ENDURANCE UAV (1)	LOW COST INFRARED MAPPER - NADC	BATTALION TARGETING SENSOR DEMONSTRATION LABCOM (2) UAV MTI RADAR TECH CONCEPT DEMO - LABCOM	
DATALINKS		LOW COST UAV COMMUNICATION - NADC (1) COMPRESSION SCHEMES FOR UAV SENSOR DATA - NAVAIR (1) ULTRA WIDEBAND RADAR/DATA LINK - NAVAIR (1)		UNMANNED AERIAL RECONNAISSANCE VEHICLE INTEROPERABILITY DESIGN STUDY - RL
MAN-MACHINE INTERFACE	STEREOSCOPIC DISPLAY SYSTEM (1)	AUTOMATION TRADEOFFS ANALYSIS TOOL - NAVAIR (1)	BATTALION TARGETING SENSOR DEMONSTRATION LABCOM (2)	FIELD TRAINABLE MISSION ADAPTABLE UAVS - ESD (1)

(1) Small Business Innovation Research
(2) Balanced Technology Initiative

LEGEND:

DTRC - David Taylor Research Center, Carderock, MD
ESD - Electronic Systems Command, Bedford, MA
LABCOM - US Army Laboratory Command, Adelphi & Ft Meade, MD
NADC - Naval Air Development Center, Warminster, PA
NAPC - Naval Air Propulsion Center, Trenton, NJ
NAVAIR - Naval Air Systems Command, Washington, DC
NRL - Naval Research Laboratory, Washington, DC
RL - Rome Laboratory, Rome, NY
WL - Wright Laboratory, Dayton, OH

Figure 13 - UAV Technology Efforts

X. TEST AND EVALUATION

Joint UAV testing consists of both development test and evaluation (DT&E) and operational test and evaluation (OT&E). It utilizes personnel, test sites, and test facilities of all the Services. DT&E and OT&E will generally be conducted sequentially at those test sites capable of hosting UAV system level testing. Testing may occur in parallel at several UAV test sites in order to minimize costs, exploit special test capabilities, and expedite test schedules.

Government test sites possessing sufficient restricted airspace, ground space, and sea space to conduct UAV testing are limited in number and are generally located in the western portion of the US. Most of these test sites have workloads that normally require the prioritization of onboard test projects. However, a review of UAV suitable test sites indicates that sufficient test capabilities do exist to support all UAV DT&E albeit at different test sites. Thus, little new investment in test facilities/capabilities is needed. A UAV DT&E strategy which uses both multiple and existing government test sites, depending on specific capabilities, availability, and cost, enhances the probability of completing all testing of UAV systems in a timely and cost-effective manner.

While the successful completion of UAV DT&E is seemingly straightforward, OT&E presents more challenge for two reasons. First, experienced military personnel serving in operational UAV units will be required in some measure to support OT&E. Because the number of operational UAV units is presently very small and heavily committed to contingency operations and training exercises, the availability of experienced UAV personnel is less than desired. Operation Desert Storm is a prime example. Secondly, operational test realism requires that OT&E be conducted at test sites possessing natural environments representative of operational deployment regions. Operational realism also requires the participation of various interfacing and supporting units and the presence of many complex target arrays. Establishing OT&E test criteria with adequate representative user personnel, multiple test sites, interfacing and supporting units, and complex target arrays requires a difficult balance of resources. Thus operational test realism for UAV systems is substantially driven by the availability of experienced personnel, representative test sites, and resources.

The Pacific Missile Test Center, Pt. Mugu, CA, has been designated as the lead field activity for UAV DT&E for the UAV JPO. A joint test coordinator at PMTC coordinates UAV DT&E and supports UAV OT&E as requested. The Navy Operational Test and Evaluation Force has been designated as the lead operational test agency for UAV OT&E.

XI. INTEGRATED LOGISTICS SUPPORT AND TRAINING

A. INTEGRATED LOGISTICS SUPPORT

The consolidation of the Services' UAV integrated logistics support (ILS) operations under one Service's logistics management activity offers a number of advantages. Significant efficiencies will result from establishing a center of logistics expertise. Some of the greatest payoffs from joint programs are efficiencies and economies that can accrue through combined logistics support arrangements. The concept for the Joint Logistics Center of Excellence (JLCOE) was developed to provide a common approach to planning and managing the logistics support of multi-Service UAV programs. The JLCOE builds on the basic ILS/logistics support analysis (LSA) foundation in order to address the logistics disciplines for uniform application in a joint program environment. The JLCOE is a special management approach to provide centralized authority and responsibility for the accomplishment of ILS tasks across the UAV family of systems. This involves the integration of common and differing, but related, ILS functional requirements which must eventually work together to achieve UAV program supportability goals.

The logistics activity designated as the JLCOE must provide the decision making and management required to carry out acquisition and operational functions. The organization must also provide a disciplined, stable yet flexible, approach to deal with the technical and analytical requirements of the logistics process. The JLCOE located within the Army Missile Command (MICOM) structure at Redstone Arsenal, AL, is an existing logistics activity that will be chartered by the Joint Logistics Commanders. MICOM will provide centralized ILS for all designated UAVs. Initial operation is planned for December 1991.

The JLCOE concept is flexible to allow for individual Service or program uniqueness. The overall focus for JLCOE activity is ILS element management. The JLCOE comprises the functional joint ILS working level and includes the functional expertise to plan and discharge ILS responsibilities. The structure must provide the framework for the orderly organization, management, and technical execution of selected ILS related tasks in order to satisfy various program logistics management needs.

MICOM, as the lead activity for the JLCOE, will focus on the following goals:

- Streamline ILS management and centralize the logistics staff associated with the UAV.

- Direct effort toward achievement of the UAV JPO's goal of increased logistics commonality, quality and consistent ILS performance.

Placing participating Service personnel in the JLCOE will insure harmony by addressing those business practices that might cause confusion or delays for the other Services. Assignment of skilled personnel from other Services would have the greatest impact on minimizing inter-service differences for Service unique practices. Working in concert with JLCOE personnel, the key personnel from the participating Services can help develop well conceived ILS plans that consider unique requirements in a timely manner. Actual management structure of the JLCOE will be determined by the selected organization. The JLCOE has full management responsibility for ILS across the designated UAV systems. The JLCOE will have the option of: (1) executing all the ILS requirements; (2) performing some and contracting out the others; or (3) contracting them all out. In each option, use will be made of existing centralized ILS capabilities.

B. TRAINING

The Joint Systems Training Center (JSTC), when operational in 1994, will develop, conduct, and manage training for the Services' UAV operator and maintenance personnel. In addition, the JSTC will support training demonstration/validations, OT&E, and other demonstrations. The JSTC will be a joint Service organization under the direction of the UAV JPO training agent with facilities and resources for core and Service unique training. The Army at Fort Huachuca, AZ, has been designated as the joint training agent for Short Range UAV systems. Training agents for other systems will be determined on a case-by-case basis. JSTC development activities include identification, definition, design review, set-up, and evaluation of resources.

XII. RESOURCES

DoD fiscal resources for UAV systems are managed by the UAV EXCOM and executed by the UAV JPO. Nonlethal research, development, test, and evaluation (RDT&E) and procurement UAV activities are programmed and budgeted in program element, PE 0305141O.

A. RESEARCH, DEVELOPMENT, TEST, AND EVALUATION

Most RDT&E is programmed and budgeted in OSD program element, PE 0305141D. These funds support systems, subsystems, component and interoperability and commonality RDT&E. Additional RDT&E is programmed and budgeted in related Service and agency PEs following coordination with the UAV JPO. Systems evaluated in the FCT program are funded in PE 0605130D.

B. PROCUREMENT

Procurement is programmed and budgeted in OSD program element, PE 0305141D.

C. OPERATIONS AND MAINTENANCE

Operations and maintenance is programmed and budgeted by the Services in their program elements.

D. MILITARY PERSONNEL

Military personnel end strengths and pay are individually programmed and budgeted by the Services.

E. MILITARY CONSTRUCTION

Military construction (MILCON) programming for UAVs is the responsibility of the UAV JPO. Service unique construction is the responsibility of the requiring Service.

F. FUNDING

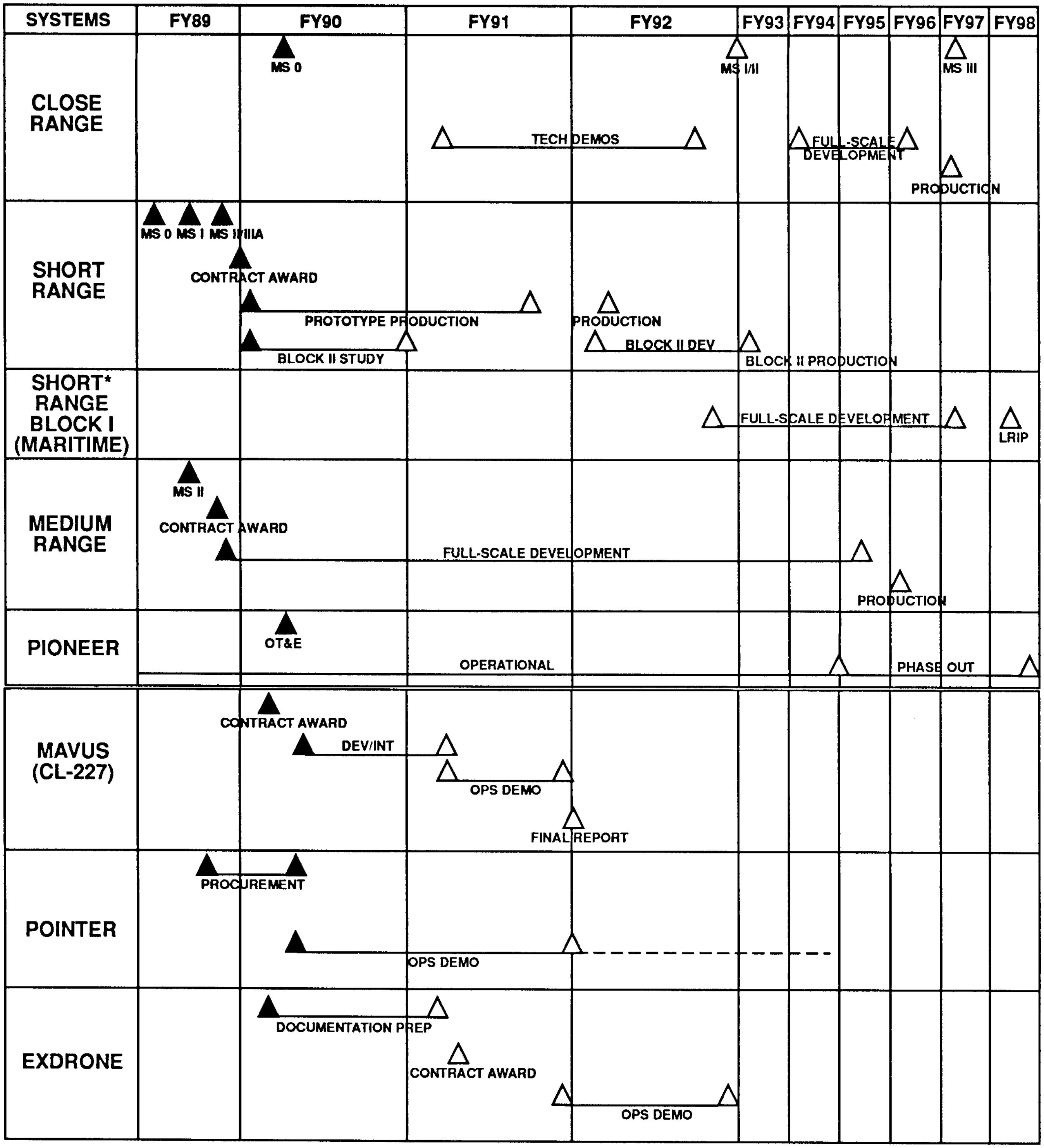
The OSD PE 0305141D budget is:

	FY91	FY92	FY93
RDT&E	$92.1M	$68.6M	$83.4M
PROCUREMENT	$25.2M *	$138.4M	$206.9M

*Includes $1.0M appropriated for counternarcotic applications.

APPENDIX A: UAV MASTER SCHEDULE

AS OF 1 March 1991



* Unfunded in the FY92/93 President's budget submit.